

NEW SPECIES OF SILURIAN FOSSILS FROM THE EDMUNDS
AND PEMBROKE FORMATIONS OF WASHINGTON
COUNTY, MAINE.

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INTRODUCTION.

In preparing the Eastport folio of the United States Geological Survey for publication the more characteristic fossils of the Silurian formations there mapped were selected for illustration. Among them the following were new, and as the folio is an inconvenient place for publishing descriptions of new species, the following paper will describe and illustrate a few of the more common and characteristic new species found in the Edmunds and Pembroke formations of Washington County, Maine. The type-specimens of all of these new species are in the collections of the United States National Museum, and the catalogue numbers under which they are registered are indicated in the following descriptions. For greater precision the Geological Survey locality numbers and my own numbers given to individual specimens are also noted wherever necessary.

The species from the Edmunds formation are:

Whitfieldella edmundsi.
Chonetes edmundsi.
Chonetes cobscookii.
Brachyprion shaleri.

Palaeopecten cobscookii.
Palaeopecten transversalis.
Tolmaia compestris.
Pterinea (? *Tolmaia*) *trescottii*.

The Pembroke species are:

Chonetes bastini.
Camarotoechia leightoni.
Actinopteria bella.
Actinopteria fornicata.
Actinopteria dispar.
Lingula scobina.

Grammysia pembrokeensis.
Lingula minima var. *americana*.
Modiolopsis leightoni.
Modiolopsis leightoni var. *quadrata*.
Nuculites corrugata.
Leiopteria rubra.

On plate 30, illustrating the Pembroke fauna, are also included figures of *Dalmanella lunata* (Sowerby), and on plate 31, *Eurymyella shaleri* var. *minor*, Williams, the type of which was described from the Eastport formation,¹ (formation No. V), and figures of *Platy-*

¹ Proc. U. S. Nat. Mus., vol. 42, p. 387, pl. 49, fig. 9.

chisma helicites (Sowerby) and *Grammysia triangulata* (Salter), species found typically in the Ludlow formation of Great Britain.

In a paper entitled "Correlation of the Paleozoic Faunas of the Eastport Quadrangle, Maine,"¹ I described briefly the subdivision of the rocks of the Eastport quadrangle into six formations, speaking of them as formations I, II, III, etc., and mentioned some of their characteristic fossils. In the course of preparing the Eastport folio, the following names have been adopted for these several divisions, viz:

- Formation No. I = Quoddy shale.
- Formation No. II = Dennys formation.
- Formation No. III = Edmunds formation.
- Formation No. IV = Pembroke formation.
- Formation No. V = Eastport formation.
- Formation No. VI = Perry formation.

As indicated in the paper above referred to, the formations I to V, inclusive, are of Silurian age, and formation VI is Devonian.

FOSSILS OF THE EDMUNDS FORMATION.

BRACHIOPODA.

Genus WHITFIELDELLA Hall and Clarke.

WHITFIELDELLA EDMUNDSI, new species.

Plate 29, figs. 1, 2, 3, 4.

Cf. 1839. *Atrypa didyma* SOWERBY, Sil. Syst., p. 614, pl. 6, fig. 4.

Description.—Shell small; valves about equally convex, sub-pentagonal, about as wide as long; beak, small; front with a furrow in each valve reaching nearly to the beak; furrow on pedicle valve slightly longer and wider than that on the brachial valve. Brachidium of two cones opposed as in *Merista*, each cone composed of 8 or 9 coils. The connecting loop unknown. No medium septum in the brachial valve. Dimensions of figured specimen 13.2 mm. wide by 11.9 mm. from beak to front; another specimen 12.7 mm. by 11.6 mm.

Formation and locality.—Edmunds formation, Burnt Cove, east shore, south of Cunningham Mountain, Edmunds Township, Washington County, Maine, loc. No. 5.5 1.5 B.

Cotypes.—Cat. No. 58944 U.S.N.M.

Comments.—This small species resembles very closely in exterior form and size the species figured and described by Sowerby under the name *Atrypa didyma* (*Terebratula didyma* Dalman).

Sowerby's description is:

Nearly globose; beaks small; front emarginate, with a furrow in each valve reaching nearly to the beaks. Length, five lines; width the same.

¹ Bull. Geol. Soc. America, vol. 23, pp. 349, 356.

Our species is, however, less globose and smaller than Sowerby's figure of *Atrypa didyma*. The surface is smooth except for concentric growth lines on the outer half of the shell. The interior of the pedicle valve (see fig. 4) shows the disposition of the dental plates and muscular scars as represented by Davidson's¹ figure of the enlarged interior of a pedicle valve of "*Meristella didyma*" which resembles *Hyattella* and *Meristina* more than *Whitfieldella* Hall. The scar on the brachial valve is linear and there is a hinge plate; whether cleft or not is not evident, but there is no medium septum. The spiral ribbons are arranged in two cones opposed as in *Merista* and *Hyattella*. There appear to be at least 8, perhaps 9, coils each side. None of the specimens show with distinctness the jugum and central lamellæ, but the parts preserved are well represented by the figures given by Davidson of the spirals of "*Meristina didyma*." ²

From these observations it is evident that our species represents the form originally described by Sowerby under the name *Atrypa didyma* Dalman.

From the fact that it does not have the prominent beak of the Gotland specimens,³ a form which was included under the same name by Davidson⁴ it does not seem clear that the British form figured by Sowerby is specifically the same with *Terbratula? didyma* Dalman. It is also uncertain what may be the interior characters of Sowerby's original specimens. Under these circumstances a new specific name is appropriate, although there are not in evidence characters by which the Maine species may be specifically distinguished from the form described and figured by Sowerby. The specific name *Whitfieldella edmundsi* is therefore proposed for this species.

Generically it is difficult to assign the species strictly to any one of the genera in use. The absence of a medium septum from the brachial valve technically excludes it from *Whitfieldella* which was erected with the species *Atrypa nitida* Hall as type. *Meristina* Hall and *Whitfieldia* Davidson also are defined as having a median septum in the brachial valve. *Hyattella* Hall, closely related to *Whitfieldella* Hall, has no median septum. In this dilemma and until fuller knowledge of the characters are ascertained I will provisionally refer the species to Hall's genus *Whitfieldella*, recognizing Davidson's reference of Sowerby's species to *Meristina* and using the term *Whitfieldella* in the larger sense as the name "proposed as a substitute for the term *Meristina* in its current application to species not congeneric with *M. maria*." ⁵

¹ Sil. Brach., pl. 12, fig. 9.

² Brit. Pal. Brach., suppl., pl. 4, figs. 23 and 23a.

³ Hall and Clarke Pal. New York, vol. 8, pt. 2, pl. 11, figs. 14, 15.

⁴ Brit. Sil. Brach., pl. 12, figs. 4, 8.

⁵ Pal. New York, vol. 8, pt. 2, p. 60.

The *Atrypa didyma* described by Sowerby is smaller than the species as afterwards identified by Davidson. The dimensions given by Sowerby are: length, 5 lines; width the same, whereas Davidson gives the dimensions of the two specimens cited as 11 by 10 and 10 by 10 lines. The dimensions of two specimens of *Whitfieldella edmundsi* are $5\frac{1}{2}$ by 6 and 6 by $5\frac{1}{2}$ lines, or approximately the size of Sowerby's specimens from the Aymestry. Our species approaches in form more nearly that of Davidson's specimen, figures 6 and 7, from the Wenlock than the Aymestry form figured by Sowerby. The species as figured by Hall and Clarke and named *Whitfieldella didyma* Dalman approaches more nearly Davidson's figure 4, also a Wenlock form, but the figure does not show a furrow in the brachial valve. Sowerby describes his species as having a furrow in each valve. Davidson includes in his definition those with furrow in each valve and those with "valves regularly and moderately globose."

In form and size (external) *W. edmundsi* resembles most closely *Atrypa nucleolata* Hall, which is listed by Schuchert as *Whitfieldella*(?) *nucleolata*. In *Whitfieldella*, however, there is a distinct median septum in the brachial valve supporting a concave hinge plate. There may be a simple pointed process terminating the loop as in that genus but the termination is missing in all our specimens. The probability that it is simple is inferred from the cast of a single perforation in center between the inner ribbons of the spiral coil.

Atrypa nucleolata was regarded by Hall as very closely approaching *A. nitida* and distinguishing characters mentioned are its less elongate form, and the more conspicuous furrow in the dorsal valve of the Coralline species, and in the description furrows on both valves are recognized, though not always present. These resemblances are of external characters, and the close relationship existing between *A. nitida* Hall and *A. didyma* Dalman was recognized by both Davidson and Hall and Clarke, the difficulties arising in determining the internal characters. I have no evidence by which to distinguish the internal characters under dispute. One of our specimens exhibits the spiral brachial supports and the loop running interiorly connecting the two inner arms but the exact nature of their termination is not evident. The species therefore comes within the definition of *M. didyma* Dalman in its external and so much of internal character as can be made out. It may be identical with *A. nucleolata* Hall, but if so that name is probably a synonym for *M. didyma* (Dalman). Generically, I am inclined to believe, it should remain in the same genus with *Meristina tumida*. In one specimen I find a broad jugum and accessory plates parallel to the first volution of the brachia, like *Athyris*. The characters require further study.

Genus CHONETES Fischer de Waldheim.

CHONETES EDMUNDSI, new species.

Plate 29, figs. 6, 7, 8, 9.

Description.—The typical characters may be defined as follows, namely: Size, small, rarely wider than 12 mm. and generally less than twice as wide as long; pedicle valves convex, arching up from the cardinal border abruptly at the umbonal region, and flattened at the cardinal angles; body of shell swollen; brachial valve flattened, concave; radii occasionally bifurcating, but over body of shell radii simple to near front; radii on the ears near the cardinal border much finer and fainter than over body; 60 to 90 radii can be counted at the margin, the larger total number due mainly to increase in the number of fine radii on the flattened cardinal angles; spines four on each side of the beak, the outer ones larger than the inner; in an occasional large specimen five spines have been counted.

Formation and locality.—Edmunds formation: Calcareous shales about one-half mile south of Field Point on west shore Cobcook River (loc. No. 8.21.1A); west side of Burnt Cove (loc. No. 5.51.5A); Field Point (loc. No. 8.1.8A); extreme northwest corner of cove, near outlet of Roaring Lake, southern part of Edmunds (loc. No. 7.42.6A), all in Edmunds Township, Washington County, Maine.

Cotypes.—Cat. Nos. 58945, 58946, U.S.N.M.

Comments.—*Chonetes edmundsi* Williams. In the fauna of 5.51.5A is found a *Chonetes* which presents some of the features of *C. striatella*, but is distinctly smaller. Only four specimens have been seen (Nos. M1483.1, 2, 3 and M1158).

Specimen No. M1158 is the mold of the exterior of a pedicle valve the front edge of which is wanting, so that the length is estimated. Dimensions are 10 by 6 mm. The umbo is not elevated and the convexity of the umbonal region is slight. There appear to be 4 spines each side the middle, which in the specimen appear to be short. The ears are flattened, and on them the radii occasionally bifurcate and are about 40 at the margin.

Specimen No. M1483.1 is the exfoliated mold of, probably, a pedicle valve; the spines on the cardinal margin are indistinct, but faint traces of 3 of the 4 are evident on the left side. The beak is not projecting, and the umbonal region at the margin is little elevated, but the central part of the shell is roundly swollen and the ears flattened. The radii are about 40 at the margin, and they occasionally dichotomise in growth. Dimensions are $11\frac{1}{2}$ by nearly 7 mm.

Specimen No. M1483.2 is a partly exfoliated pedicle valve, without any trace of the spines visible, and the portion of shell present appears to be perforated by some borings and is smooth. This may be the

original state or the surface worn off by attrition. The mold of the interior shows faint radii, apparently more numerous than on the other specimens. Some of the radii bifurcate. They are too indistinct to be counted, but over the central part they are arranged more closely together than on the corresponding surface of the other specimens. The dimensions are 13 by 10 mm. The umbonal portion is low, but the beak is slightly pointed. The body is at first flattened, tapering off gradually to the cardinal angles, but is swollen in the center and arched over toward the front. The specimen is imperfect, but the cardinal angle appears to have been slightly mucronate, and the characters thus suggest its relationship to the form described as *Leptæna lævigata*, or *Chonetes lepisma*, by Sowerby. I refer it provisionally to *Chonetes lepisma*.

Specimen No. M1483.3 is a mold of the exterior of a pedicle valve showing the spines faintly, 4 in number. The umbonal region is depressed and the center part swollen slightly, with a broad shallow furrow down the center. The sides flatten toward the cardinal angles. The radii, which occasionally bifurcate, are quite distinct over the right half of the specimen, 25 of which can be counted from the cardinal angle to the central line, making (if the same on the other half) 50 radii. The dimensions are 12 by $7\frac{1}{2}$ mm.

Chonetes edmundsi H. S. Williams, types. The specimens M1158, 1483.1 and 3 present closely similar characters, and to the types I apply the name *Chonetes edmundsi*. They are longer than typical specimens of *Chonetes cornuta* Hall, and have a greater number of radii. They also resemble *Chonetes tenuistriata* Hall, but have less number of radii. They also closely resemble the forms from the Pentland Hills referred to *Chonetes striatella* by Davidson, of which Davidson says, "the Scottish specimens being much smaller than those which occur in England and in Sweden" (p. 21), as is also shown by the figures,¹ of which the dimensions given in the description are, length 2, width 3 lines.

While it is probable that this Pentland species is the same as our *Chonetes edmundsi*, my definition is based upon our specimens, and I assign to it a new specific name, which may include the small forms referred to *Chonetes striatella* by Davidson.

Another series of the same form coming from loc. No. 8.1.8A is numbered M1556.1-4.

Specimen No. M1556.1, a mold of the exterior of a pedicle valve, dimensions 11 by 6 mm., shows well-developed umbones, arching up rapidly from the cardinal margin, with broad convex body and the sides exhibiting only a small flattened area at cardinal angles. The radii, of which there are about 80 at the margin, bifurcate more

¹ Pl. 3, figs. 14, 14a and 14b.

frequently than in the lot just described. The hinge area is covered so that the spines are not in evidence.

Specimen No. M1556.2 is an external cast of the exterior of a pedicle valve 9 by $5\frac{1}{2}$ mm., showing 4 spines on each side. The beak is inconspicuous, but the body rises abruptly from the hinge margin, forming a convex body with cardinal angles not much flattened, a slight narrow depression along the middle. Radii are over 60 but not 80.

Specimen No. M1556.3 is the mold of exterior of a brachial (?) valve, dimensions 12 by $6\frac{1}{2}$, radii about 60, bifurcating frequently and early, as do all the specimens from this locality.

Specimen No. M1556.4 is a similar shell, but imperfect and a little smaller, showing the same size and form as specimen from 5.51.5A except in having a less flattened area at the cardinal angle, the rise from the cardinal border is more rapid and the radii bifurcate more frequently and earlier, increasing the number of radii at the margin.

Specimens Nos. M1547.1-3 comprise another set from loc. No. 7.42.6A. M1547.1 is a somewhat distorted pedicle valve 11 by 6 mm. The radii are not distinct over the whole surface, but will reach about 80 in number. No evidence of the spines can be seen; the body rises abruptly from hinge area and the cardinal angles are but slightly flattened.

Specimen No. M1547.2, dimensions about 10 by 7 mm, somewhat distorted convex and with distinct flattened area at cardinal angle, body convex, about 65 radii.

Specimen No. M1547.3, a specimen of pedicle valve distorted slightly and showing general characters of No. 1547.2.

Specimen No. M1554 is an imperfect pedicle valve, dimension about 10 by 5 mm., radii about 60, one spine base evident; convex, broad body with but slight flattening at ears.

Specimen No. M1516, probably the interior of a brachial valve slightly convex, regularly so in specimen, but as interpreted a concave valve. Radii as near as can be estimated about 55, bifurcating occasionally.

Specimens Nos. M1555.1-5 are from loc. No. 5.33.8A; 1 and 2 are quadrate low, convex forms which appear to be pedicle valves; dimensions No. 1, 9 by 7 mm.; No. 2, $9\frac{1}{2}$ by $6\frac{1}{2}$ mm.; beaks low, narrow, and rising gradually from hinge area, with broad flattened area at angles, and the body only moderately convex; radii often dichotomizing twice before reaching the front and resulting in a full hundred at border, the lateral ones faint and finer than over body. These come very close to Hall's *Chonetes tenuistriata* from the Arisaig. The specimens Nos. 1 and 2 are a little longer proportionately than Hall's figure; 3, another crushed specimen probably had near the

same character when perfect and two others more or less crushed and imperfect show like characters.

In the fauna of locality No. 8.21.1A two types of *Chonetes* appear, the first of which presents the typical character of *Chonetes edmundsi* as seen in the lower faunas, where it is the only representative of the genus *Chonetes*. This series is numbered M1156. 1 to 9.

Specimen No. M1156.1, dimensions $11\frac{1}{2}$ by 7mm., has the umbonal region strong and arching up directly from the hinge area, arching over to the front, making the central portion of the body swollen and the cardinal angles flattened. Four spines are visible on right side, larger at outer end and incurved. The radii occasionally bifurcate, are somewhat finer on ears, and at front are about 80 in number.

Specimen No. M1156.2, dimensions about 13 by 8 mm., is a mold of exterior of pedicle valve and shows 5 spines each side. The 10 or 12 radii at the extreme cardinal corners are very fine, and with the others will make over 90, but the form and the size of radii over the body of shell are not distinguishable more than varieties from the other specimens.

Specimen No. M1156.3 is a smaller specimen, 9 by 6 mm., a pedicle valve. There are about 60 evident radii and those on the ears indistinct; if in same proportion to other shells they would number to 75 or 80. The shell is a mold of the interior. This shows the typical form of *C. edmundsi*, except it is a little longer proportionate to width, possibly due to crushing.

Specimen No. M1156.4, dimensions $9\frac{1}{2}$ to $5\frac{1}{2}$ mm., arched and swollen central part, with the ear portions less flattened, presenting the form of the larger more typical form. This has the radii of same size, only occasionally bifurcated and making, if all could be counted, about 75 to 80 at edge.

Specimen No. M1156.5 is a specimen of the other species which I identify with the forms of *C. novascotica* Hall seen in the Waldron, of which mention will be made later.

Specimen No. M1156.6 is a larger and somewhat distorted form, the edges of which are indistinct and the reference is doubtful. It has the general character of *C. edmundsi* except it is larger; width $14\frac{1}{2}$ by length 9 mm., and the radii will reach over 90.

Specimen No. M1156.7, mold of interior of brachial valve, dimensions 13 by $7\frac{1}{2}$ mm. and radii 75-80. This valve is concave and in the mold shows the gradual arching without prominence of umbonal part seen in the pedicle valve.

Specimen No. M1156.8 is a more perfect mold of interior of brachial valve, concave but slightly so, showing nearly flat in the specimen. Radii are 65-75 in number.

Specimen No. M1156.9 is a typical pedicle valve, dimensions 11 by $6\frac{1}{2}$ mm., abruptly arching from the hinge area; body convex, ears

flattened; radii only occasionally bifurcated and that mostly near edge, and total about 80. These all retain the typical characters of the species *Chonetes edmundsi* with certain fluctuations.

Although this species is found associated with *C. novascotica*, it differs from the latter in the greater convexity of the pedicle valve, deeper concavity of brachial valve, and the radiating lines on the surface are much finer, rarely over 80 and often scarcely 60. The species is of the type of *C. striatella* Dalman, but differs from that form (as seen typically at Eastport in the fauna 5.33.8B) in its smaller and shorter form and in its less lateral extension. The average size is about 8 by 13 mm., whereas a small form of typical *C. striatella* is 9 by 15 (M1420.7), another (M1420.4) is $9\frac{1}{2}$ by $18\frac{1}{2}$. The rays are about the same size as in *C. striatella*, as are also the cardinal spines, and the species may be taken as representing the form represented by Davidson's smaller figure 25*a* and by De Konnick's figures 5*a, b, c, d*, of shorter form with proportions 14–22. The ordinary proportions given by De Konnick are 100; 182; 27; 8 as compared with the 100; 157; 40; 9, the more swollen form.

CHONETES COBSCOOKI, new species.

Plate 29, fig. 5.

Cf. 1860. *Chonetes novascotica* HALL, Canadian Nat. Geol., vol. 5, p. 144, fig. 2.

Shells are flattened with the front often a little arching, but the umbonal portion is always low and but slightly rising above the cardinal margin. The brachial valve is nearly flat, slightly concave. The spines are 5 or 6 on each side and slender, curved inward, outer ones longer than inner. The radii bifurcate frequently over the whole surface and at two or three points in course of growth, resulting in a nearly uniform fine size of radii which at the front reach a number as great as 150 or 200.

In the typical specimens of this locality the arching over at the front is slight and the form is therefore flattened-convex. A central radius is occasionally present with double the size of the ordinary radii, running from the beak to the front without bifurcation. Specimens are seen on the slabs as small as 11 mm. broad and 7 or 8 mm. long, and one specimen is 17 broad by 9 long. The lateral growth does not reach double the length, though the width is generally three-quarters greater than the length.

Formation and locality.—Edmunds formation, calcareous shales south of Field Point, west shore Cobscook River, Edmunds Township (loc. 8.21.1A).

Holotype.—Cat. No. 58949, U.S.N.M.

Comments.—The dimensions of Hall's figures of the type of *Chonetes nova scoticus* are, breadth $20\frac{1}{2}$ at the hinge margin and 22 in middle of shell and 15 mm. from beak to front. The form called *Chonetes*

tenuistriata Hall is 10 by $10\frac{1}{4}$ by 6 mm. It is said to be "more finely striated than the preceding," i. e., *C. nova scoticus*. Our shells from S.21.1A appear to have "greatest width near the middle," which agrees with the original figure and is inserted in the description of the species so identified from the Waldron shale.¹ Our specimens are, however, very little convex, and not noticeably, "more ventricose than *C. cornuta* of the Clinton," though considerably larger than the original type as figured.

Specimens in the Cornell University Museum (originally belonging to the Jewett collection and marked "*Chonetes cornuta* Hall" from the Clinton formation New Hartford, New York, Cat. No. 2197) show considerable variation in size. Dimensions of the smallest specimens are 5 by 3 mm., the largest 15 by 8 mm. The radii are very similar to those of Maine specimens of the same size, are in the larger specimens over 100 at the margin, and the median radii are double strength, as said to be characteristic of some of the specimens from Arisaig and particularly of the specimens from Waldron called *Chonetes nova scoticus*. The form of *C. cornuta* varies but the specimens referred to are none of them fully twice as broad as long, though nearly so.

The original specimen figured by Hall of *C. nova scoticus* has not the strong central radii, but in the text "a stronger and more elevated stria," it is said, "often marks the median line from the beak to base of ventral valve."² It is difficult to determine what morphological characters belong to these specific names as used. The definition of *C. tenuistriata* makes it to be more finely striated than *C. nova scoticus*, also larger and more finely striated than *C. cornuta*, but the number of striæ on the margin of *C. tenuistriata* is given as nearly 100, whereas the striæ are given as "more than 100 on the margin of *C. nova scoticus*."

The specimens in the Cornell University collection from the Clinton are much more finely striate than the figures given of the species *C. cornuta*.³ The increase in number of radii is produced by dichotomising or interstitial additions in course of growth, and hence the larger the size of a given species (supposing the rate of increase were uniform) the greater would be the resulting number of radii at the margin. Fluctuation also takes place in the growth laterally in relation to the length.

The form I call *C. edmundsi* is a small species with the dichotomising process rare, as in typical *C. striatella*, and the lateral growth not reaching twice the length. The form I call *C. striatella* attains ordinarily more than twice the dimensions of *C. edmundsi*, the striæ occasionally but rarely bifurcate except at the cardinal angles, and

¹ 28th Ann. Rept. N. Y. State series, p. 155.

² Acadian Geol., 4th ed., p. 596.

³ Pal. N. Y., vol. 2, pl. 21, fig. 10.

the lateral growth is double the length or even more and the number of radii at the edge is less than 100.

The form I name *C. cobscooki* is very close in outline to the Waldron form figured by Hall as *C. nova scoticus*, is somewhat larger, but shows evidence of at least 4 and sometimes 5 spines on each side. It is not "more ventricose than *C. cornuta*," but in some specimens is less so than seen in examples from the Clinton formation of New Hartford. The striæ are frequently bifurcated two or three times in course of their growth and reach a greater number than 100 at the front margin.

Genus BRACHYPRION Shaler.

BRACHYPRION SHALERI, new species.

Plate 29, figs. 10, 11, 12.

Shell of medium size, flat, semielliptical, wider than long, greatest width at cardinal edge. Pedicle valve slightly convex throughout its growth, brachial valve slightly concave. Surface ornamented by elevated thread-like radii of two sizes, the larger about 20 near beak and increasing to about 50 at the front, between which are finer lines becoming 5 to 8 in central shell, but one of them rising to strength of the primary radii divides them into 4 or 5 small between each large radii near the front border. The cardinal border is crenulated each side the middle for a third the distance to end of hinge line. The dental laminae of the pedicle valve are strong and continued as slightly diverging ridges each side the muscular scar, about one-third the length of the shell. A linear median septum of about the same length divides the muscular scar into two lobes. The ridges from the outer face of the dental sockets of the brachial valve are strong; from the inner side of each proceeds forward a strong linear ridge, curving gently outward and extending halfway to the front, the two bounding the muscular scars.

The species closely resembles *Strophonella striata* (Hall), but differs from it in being convexo-concave throughout growth, showing no tendency to resupination. The shell is not perfectly symmetrical in its convexity, showing in some specimens of the pedicle valve slightly greater convexity on one side than the other, but in no specimen is reversal to concavity exhibited in course of growth, which feature excludes it from the genus *Strophonella*. The type-specimens are from the west shore of Cobscook River, south of Ball's Mountain, in Edmunds Township (localities 8.21.1A and 5.51.5B).

Specimen No. 1414.3 (pl. 29, fig. 12), an interior mold of a brachial valve, shows that valve to have been concave, and exhibits the characters of the central part of the shell in mold. Comparison with figures 4 and 8 of the same plate will show the differences between the brachial valve of this species and *Leptostrophia*.

Figure 7 shows a mold of the interior of a pedicle valve (magnified 2 diameters). It exhibits the characteristic ridges bounding the muscular scars which may be compared with the corresponding views of pedicle valves of *Leptostrophia filosa* illustrated by figures 1 and 2, which are natural size, and 9a, which is magnified 2 diameters.

Leptostrophia filosa which occurs in the same beds with this species is flatter, though *Brachyprion shaleri* is also nearly flat.

Formation and locality.—Edmunds formation from the outcrops on the east shore of Burnt Cove, south of Cunningham Mountain (loc. No. 5.51.5B), and west of Field Point, southeast of Ball's Mountain (loc. No. 8.1.8A), and west shore of Cobscook River, opposite Wilbur Point (loc. No. 8.21.1A), all in Edmunds Township, Washington County, Maine.

Cotypes.—Cat. Nos. 58950, 58951, 58952, U.S.N.M.

ON THE GROUP OF AVICULOID SHELLS CALLED AVICULA? DANBYI
BY M'COY.

Frederick M'Coy published in the *Annals and Magazine of Natural History* in 1851 the description of some aviculoid shells found abundantly in the greenish quartzite (Upper Ludlow rock) of Benson Knob, Kendall, Westmoreland, under the name *Avicula? danbyi* (M'Coy).¹ With this original description no figures were published. Later in *British Silurian Rocks and Fossils*,² 1855, the species was redescribed and five figures were published. In both places doubt was expressed as to the reference of the species to the genus *Avicula*. The discovery in the Edmunds formation of the Eastport quadrangle, Maine, of specimens evidently belonging to this group of forms has led to a critical study of them and of M'Coy's descriptions and figures with the result of discriminating certain distinct generic characters for the group, resolving the forms described by M'Coy into two distinct species and the recognition of a new species among the Maine representatives of the genus.

M'Coy, in writing his description, evidently had before him specimens of each of the three specific forms, recognizing the wide range of variability and writing his description to cover the middle species. This is indicated by his giving "average" dimensions, by the statement that the species "varies much in the amount of its obliquity and transverse elongation and the number of radiations on the left valve," also "some of the varieties are so slightly oblique as to assume a rotundate-quadrate form."

In resolving the group into its constituent species I have taken the form represented by figure 13 of his plate 1*l*. as most closely conforming to his definition of the species *Avicula? danbyi*. The figures 11 and 15 represent a small and a large specimen of the same species.

¹ *Silurian Mollusca*, *Ann. Nat. Hist.*, ser. 2, vol. 8, 1851, p. 59.

² *Idem*, p. 258, pl. 1*l*., figs. 11-15.

The second species is much more transversely elongate and has the anterior ear distinctly rounded without reentrant curve to the anterior border; for this form I propose the specific name *transversalis*.

Reference also is made, in the comments upon the species after its description, to a "rotundato-quadrate form." This is probably a representative of the form I am describing as a new species under the name *Palæopecten cobscooki*, making it the type of the new genus *Palæopecten*, which appears to include all the forms gathered under the name *Avicula? danbyi* by M'Coy.

PELECYPODA.

PALÆOPECTEN, new genus.

The genus combines certain characters which in later geologic times are found separated in different genera and distributed in the separate families Pectinidæ and Aviculidæ of modern writers. The shell is inequivalve and inequilateral. In the type species the shell is nearly symmetrical as in typical *Pectens*; in other species, intimately associated with it by intermediate forms, the shell is conspicuously inequilateral, the posterior body of the shell being much produced as in the genus *Follmamella*. Anterior ear and posterior wing both developed, the posterior wing larger than the anterior ear, both flattened, and no distinct evidence of byssal sinus. Cardinal border straight and shorter than transverse diameter of body of shell. Left valve gently convex, beak low, inconspicuous, within the middle third of the cardinal border. Right valve flattened, slightly convex transversely across the umbonal region but distinctly concave (dishing) from beak to front margin. Ligamental area of hinge distinctly marked by fine longitudinal lines; and under the beak of the left valve a distinct triangular cartilage pit. Two strong diverging ridges are seen, one each side the beak of the left valve, of about 5 to 8 mm. length in the type species (crural ridges). In the transverse species these crural ridges are less strong but longer than in the type species. The shell substance was apparently thin; the surface lines and foldings show with almost equal distinctness in interior molds and on exterior surfaces. These surface markings consist of fine linear concentric striæ and rather broad, irregular concentric foldings crossed on the left valve by obtuse ridges radiating from the beak and generally becoming obsolete toward the margin. Over the umbonal region the radiating ridges are separated by flattened furrows little wider than the ridges; but toward the front the furrows become several times the width of the ridges, and occasionally a secondary ridge develops between two adjacent primary radii. In size the specimens vary from 1 to 3½ inches in transverse diameter.

Type-species.—*Palæopecten cobscooki*, new species.

PALEOPECTEN COBSCOOKI, new species.

Plate 29, fig. 13.

Cf. *Avicula danbyi* M'Coy (part), Brit. Pal. Fos., 1855, pl. 11, fig. 12.

Shell suborbicular, erect, inequilateral but nearly symmetrical, posterior margin and wing extends backward about one-fifth more than the anterior ear and margin protrude forward of a line drawn vertical through the beak; left valve gently convex, beak elevated but not conspicuous; right valve unknown but presumably flattened or concave. The anterior ear small, flattened, angular and without evident byssal sinus; margin below it slightly incurved posterior; wing, triangular, flat, acutely pointed, a broad incurve connecting it with the protruding lower half of margin. Surface marked by fine, sharp, threadlike concentric lines and coarser ill-defined concentric wrinkles, crossed by 12 to 14 obtuse radiating ridges separated by flattened spaces which broaden toward the front and between them occasional secondary smaller ridges. These radii are distinct over the beak and central part of the shell and become faint on sides and front. The hinge margin is flattened and is marked by fine longitudinal ligamental striæ; under the beak is a distinct small cartilage pit. On the inside of the left valve each side the beak is a strong diverging crural ridge, extending 5 to 8 millimeters from the tip of beak and terminating abruptly; angle of divergence about 100° .

No evidence of either muscular scars or pallial line have been discovered. All the specimens seen of this species are left valves. The form of the right valve is inferred from a specimen of another species from the same locality, showing both valves attached. Dimensions of the type-specimen are as follows, namely: Length of cardinal area, 37 mm.; transverse diameter across widest part, $53\frac{1}{2}$ mm.; height from base to end of beak, 52 mm.; from center of beak to tip of posterior wing, $22\frac{1}{2}$ mm.; crural ridges, anterior, $5\frac{1}{2}$ mm.; posterior, 9 mm.

This species resembles M'Coy's figure 12 of *Avicula danbyi*, but it is more erect, more nearly symmetrical, and less produced posteriorly, although a larger shell, and the ear and wing are larger proportionate to the size of the body part of the shell.

Formation and locality.—In tough gray sandy shales of the Edmunds formation on the east shore of Cobscook River, on outer side of the southern point forming the inclosure of Carrying Place Cove in the town of Trescott (locality 5.52.9A), Eastport quadrangle, Maine.

Holotype.—Cat. No. 58953, U.S.N.M.

PALEOPECTEN DANBYI (M'Coy) (sensu stricto Williams).

Avicula? danbyi M'Coy, Ann. Nat. Hist., ser. 2, vol. 7, 1851, p. 59.

Avicula danbyi M'Coy, Brit. Pal. Foss., 1855, p. 258, pl. 11, figs. 11 and 13.

In revising this species it has seemed to the writer that M'Coy had before him when writing his description three forms which may be specifically differentiated. M'Coy evidently wrote the description

so as to express the average or middle species and in preparing his plates represented this typical form by the figures numbered 11, 13, and 15. I assume that figure 13 best represents the average characters of his species *Avicula danbyi*. The specific characters which apply strictly to this figure are found in his definition in the terms, "oblique ovate, posterior end more or less narrowed, rounded," "hinge line rather less than half the width of the shell," "both wings nearly rectangular, with sharply concave margins. Average length, 1 inch 5 lines; width, 2 inches 3 lines; length of hinge, line 1 inch."

Assuming these to be characters of the species *Avicula danbyi* in strict sense, it is evident that figure 14 represents a more transversely elongate form of which the anterior ear is distinctly rounded and its margin undifferentiated from the general anterior convex margin of the shell. The other extreme is represented by *Palæopecten cobscooki*, already described, which is suborbicular with height and transverse diameter almost exactly equal.

I have represented on Plate IV (of the Eastport Folio) each of these three types, as they appear in the Edmunds formation in Maine. Figures 6 and 7 are molds of the exterior of a small and a large specimen of the left valve which I identify with M'Coy's species as restricted.

PALÆOPECTEN TRANSVERSALIS, new species.

Plate 29, figs. 17 and 18.

Cf. *Avicula danbyi* M'Coy (part), Brit. Pal. Foss., pl. 11, fig. 14.

Shell obliquely ovate, transversely elongate, greatest width nearly twice the height; front margin broadly rounded, meeting the hinge line at an obtuse angle without incurve or byssal sinus. Posterior wing flattened, small, terminating in acute angle; lower half of body much produced backward beyond the end of wing. Left valve gently convex, right valve flat transversely gently concave from beak to lower margin. Left valve crossed by 12 to 14 obtuse radiating ridges, well defined over main body but becoming faint toward the margin. Surface of both valves marked by fine, thread-like concentric lines, and irregular concentric folds which are generally more marked toward the margin. Crural ridges present, one each side the beak, diverging at angle of about 150° .

Dimensions of type-specimen (No. M1407.2): Height, 33 mm.; transverse width, 67 mm.; hinge length, 40 mm.

Formation and locality.—Same as *Palæopecten cobscooki*.

Holotype.—Cat. No. 58954, U.S.N.M.

Observation.—This species is distinguished from *Palæopecten danbyi* (M'Coy) *sensu stricto*, by its more transverse form, the rounding of the anterior ear, and the absence of incurve of the anterior margin.

M'Coy's figure 14 of plate 11, Brit. Pal. Foss., appears to belong to this species.

Genus PTERINEA Goldfuss.

PTERINEA (?TOLMAIA) TRESCOTTI Williams.

Plate 29, figs. 14, 15.

Shell of medium size, rhomboidal, body oblique, longitudinal axis at an angle with the hinge line of about 60° ; length greater than height; valves unequal; left valve convex; right valve concave from beak to base, gently convex transversely across upper part but flat near basal margin. Hinge line straight, part behind beak nearly four times as great as that in front. Left-valve beak prominent, upright at origin, convex over umbonal region. Body convex, arcuate, anterior side more elevated than posterior, abruptly bounded both on anterior and posterior sides. Anterior ear strong, set off from body by deep rounded furrow; byssal sinus sharply defined, posterior wing triangular produced into short mucronate point at cardinal extremity, distinctly separated from body, posterior margin concave. Right valve broad, concave from hinge to base line, across center of shell from posterior side slightly convex, beak depressed, not protruding beyond cardinal margin. The surface markings on the left valve are composed of two sets of elevated radiating rays, the stronger set strong cord-like rays evident from front side of body to the extremity of wing, the finer set thread-like lines in bottom of furrows separating stronger rays; these are about a millimeter apart over center of body of shell. On the wing and posterior half of the body the secondary rays are absent from the upper half of the surface; on lower half the second series appear between the first set; on the anterior half of the body the secondary rays are evident well up upon the umbonal surface, and are sub-equal to the first set toward the base, where both sets appear to be lamellose. The rays are crossed by concentric lines which become lamellose over the anterior ear. Surface of right valve, as seen in a mold of the interior, is smooth with faint indication of radiating lines on basal half of body, crossed by a few broad concentric growth lines.

Teeth, anterior to beak are two to four strong, oblique, short teeth; posterior to beak two elongate lateral teeth on right valve curving a little inward toward posterior end, terminating about half way out on margin of wing. On left valve one strong lateral tooth.

Formation and locality.—Edmunds' formation, near the end or Crow Neck on the northeast side of North Trescott (loc. No. 5.33.8A).

Cotypes.—Cat. No. 58955, U.S.N.M.

Comments.—This species by its hinge and inequality of valves is distinctly within the genus *Pterinea*, not *Actinopteria*, although its external appearance recalls the Devonian *Actinopteria*s. The outline is similar to that of *Pterinea dichotoma* Krantz,¹ but the beak is

¹ Frech, pl. 9, fig. 16.

more erect and wide, and the anterior ear is larger and not so deeply incut below. Externally the species resembles the Devonian Actinopterias of Hall, but its well-developed cardinal denticulation separates it from that genus.

It differs from *Pterinea* (*sensu stricto*) as restricted by me in its development of radial rays and fails to agree with Frech's group of *Pterinea lineata* Goldfuss (= *Tolmaia* Williams) by its well-developed anterior ear.

I call it *Pterinea* (? *Tolmaia*) *trescottii* (new species), using the generic name *Pterinea* in its broader sense as including rayed as well as smooth shells, since it is evidently a forerunner of the shells of the type of *Actinopteria boydii* and *A. perstrialis* of the Devonian of New York State, but is still in hinge structure one of the Pteriniidæ.

Genus TOLMAIA Williams.

TOLMAIA CAMPESTRIS, Williams.

Plate 29, fig. 16.

Cf. *Avicula reticulata*? HISINGER, Sowerby, Sil. Syst., 1839, p. 614, pl. 6, fig. 3.

Cf. *Pterinea sowerbii* M'COY, Brit. Pal. Rocks and Foss., 1855, p. 263.

This species bears considerable likeness to Sowerby's figure of *Avicula reticulata* Hisinger, redescribed under the name *Pterinea sowerbyii* by M'CoY. It is shorter in form and has a more strongly developed ear, set off from the body of the shell by a distinct byssal sinus.

The surface markings consist of sharp elevated radii crossed by thin lamellose concentric lines, covering the whole surface of the left valve, including ear and wing, and apparently also the right valve. The interior of both valves is smooth.

The body of the left valve is convex with moderate development of the umbones, and the deepest part of the shell is near the anterior edge. The posterior side of the body slopes off gradually to the large flat wing. The right valve is less convex than the left over the umbonal region, flattens toward the middle, and turns upward toward the front, making an outwardly concave shell.

Both cardinal and lateral teeth are present; the outer edge of the hinge is flattened and marked by ligamental striations parallel to the edge.

The dimensions of the type-specimen are 3 cm wide by 2½ cm high; the largest specimen from the same locality measures 4 by 3½ cm.

Avicula macerata Conrad, figured by Hall from the Niagara group of New York,¹ resembles this species, but the surface sculpture of that species on the right valve is limited to "concentric lines" only on the body and "a few obsolete radiating striæ" on the wing.

¹ Pal. N. Y., vol. 2, pl. 59, fig. 1c.

Actinopteria reticulata Weller from the Decker limestone of New Jersey is also a closely related form.¹

Formation and locality.—Edmunds formation, Field Point, on west side Cobscook River, Edmunds Township, Washington County, Maine (loc. No. 8.1.8D).

Holotype.—Cat. No. 58956, U.S.N.M.

COMMENTS ON *AVICULA ? RETICULATA* SOWERBY.

J. de C. Sowerby described a shell from the Aymestry formation under the name *Avicula ? reticulata*, of which closely related, if not identical representatives, are found in the rocks of the Eastport quadrangle.

The original description is as follows:

Avicula ? reticulata Sowerby.

1839, Sil. syst., p. 614, pl. vi, fig. 3.

(Hisinger Petr. Suec. 57, t. xvii, f. 13?)

Ovate, broad, pointed toward the beaks, rather convex, ribbed; ribs numerous, decimated by the lines of growth; one valve nearly flat; ears unequal, one very large, right angled.

Length 2 inches, width 1 inch 8 lines.

Loc., Croft Valley, Aymestry.

Sowerby in the text records the species from the Aymestry limestone, but on page 618 it is also listed among the fossils of the lower Ludlow, loc. Myddleton Hall, Caermarthenshire, and on p. 628 from the Wenlock limestone, loc. Falfield-Tortworth.

1855, M'Coy, Brit. Pal. Foss., p. 263, redescribes the species and gives it the name *Pterinea sowerbii*. Ref. and syn.—*Avicula reticulata* (Sow.) Sil. syst., t. 6, fig. 3 (not of Hisinger nor Goldfuss). His description follows:

Sp. ch., obliquely ovate, depressed, slightly convex, greatest length along the posterior slope, which is straight and defined; posterior wing gently arched, scarcely extending beyond the shell; its posterior edge slightly and uniformly concave; surface radiated by slightly irregular obtuse ridges, about their thickness apart (five in two lines about the middle, at one inch from the beak), partially interrupted by thin concentric imbrications from one to two lines wide, having the radiating ridges obsolete, or nearly so, on their rostral half; radiating ridges of the wing rather larger, strongly marked only about the middle. Length from beak to respiratory angle two inches six lines; length of posterior wing 62/100, width of ditto 44/100; width from middle of hinge-line to ventral margin 97/100, depth of one valve 10/100.

This fine species differs from the *Pterinea reticulata* of the original Continental authors in its more elongate form, smaller posterior wing, with its gently concave posterior edge, and the comparatively few, broad, thin imbrications interrupting the radiating ridges.

Position and locality, Aymestry limestone, Leintwardine, Shropshire.

Frech² makes *Avicula reticulata* Goldfuss the type of his "*Gruppe der Avicula reticulata Goldfuss sp.*," and distinguishes this species

¹ Pal. Fauna, Geol. Sur., New Jersey, vol. 3, 1903, p. 245, pl. 22, fig. 3.

² Frech Dev. Aviculiden Deutschl., 1891, p. 34.

from Hisinger's species, which he notes was originally described under the name *Pterinæa reticulata* by Hisinger from the Upper Silurian of Gotland. Frech cites Lindström as reporting that the Gotland form belongs to the genus *Aviculopecten*.

If this be the case, M'Coy's name for the *Pterinæa* from the British Silurian referred to by Sowerby under Hisinger's name stands, and the pterinoid form will be *Pterinæa sowerbii* M'Coy, while the toothless *Aviculopecten* species will be *Aviculopecten reticulata* Hisinger.

FOSSILS OF THE PEMBROKE FORMATION.

The name Pembroke formation was adopted for formation No. IV briefly defined in my paper on the "Correlation of the Paleozoic Faunas of the Eastport Quadrangle, Maine," to which reference has already been made on page 320. In addition to the new species here figured the following described species are inserted on the plates and will reappear in the Eastport folio as illustrations of the fauna of the Pembroke formation: viz. *Dalmanella lunata* (Sowerby), *Grammysia triangulata* (Salter), *Eurymyella shaleri* var. *minor* Williams, and *Platyschisma helicites* Sowerby.

BRACHIOPODA.

Genus DALMANELLA Hall and Clarke.

DALMANELLA LUNATA (Sowerby).

Plate 30, figs. 1, 2, 3, 4, 5, 8.

1839. *Orthis lunata* SOWERBY, Sil. Syst., p. 611, pl. 5, fig. 15.

1839. *Orthis orbicularis* SOWERBY, Sil. Syst., p. 611, pl. 5, fig. 16.

1869. *Orthis lunata* SOWERBY, Davidson, Brit. Sil. Brac., p. 215, pl. 28, figs. 1-5.

This is a common upper Ludlow species of Great Britain.

Formation and locality.—Pembroke formation, shales at head of Leighton Cove, at southern end of the Pembroke peninsula, Washington County, Maine, loc. No. 5.3.8 M³, M¹, and F.

Plesiotypes.—Cat. Nos. 58957, 58958, 58959, U.S.N.M.

Genus CHONETES Fischer de Waldheim.

CHONETES BASTINI, new species.

Plate 30, figs. 6, 7, and 10.

On passing upward from the Edmunds to the Pembroke formation the *Chonetes* become very abundant, and in the latter formation show a wide range of fluctuation in all their diagnostic characters. The species to which I apply the specific name *bastini* is similar in form to *Chonetes striatella* Dalman, but differs in its finer and more numerous

surface striæ and in the number of its spines. Full-grown specimens are frequently 20 mm. wide and generally not quite 10 mm. long. The pedicle valve is gently convex; beak low; spines on the cardinal margin from 12 to 16 and the radiating striæ over 100 and occasionally as many as 200 at the margin. A short median septum is generally present under the beak of the pedicle valve. The brachial valve is slightly concave. There is no enlarged median rib on the pedicle valve, but occasionally a narrow median furrow crosses the shell at this point.

The shell differs from *Chonetes nova scoticus* Hall in its greater transverse extension; ordinarily it is twice as wide as long.

Locality.—Pembroke formation, Leighton Cove, Long Cove, and in many other localities in the town of Pembroke.

Cotypes.—Cat. Nos. 58960 and 58961, U.S.N.M.

Genus CAMAROTÆCHIA Hall and Clarke.

CAMAROTÆCHIA LEIGHTONI, new species.

Plate 30, figs. 9, 11, 12, 13.

Cf. 1839. *Terebratulula lacunosa* SOWERBY, Sil. Syst., p. 611, pl. 5, fig. 19 (not *T. lacunosa* Schlotheim of p. 624, pl. 12, fig. 10).

Cf. 1848. *Terebratulula lewisi* DAVIDSON, Bull. Soc. Géol. France, ser. 2, vol. 5, p. 330, pl. 3, fig. 30.

Subtrigonal, both valves convex and for the first $\frac{3}{4}$ cm. of growth nearly equally gibbous, the pedicle valve having a well-developed overarching beak. The pedicle valve for the first half of growth shows no distinguishable median sinus, but at the front and for a quarter way back in full-grown shells a slight sinus is formed by the depression of the central three plications and the prominence of the plications bounding the sulcus; the lateral slope, however, is gradual, the bounding plication not raised above the others. The plications are 8 on each side the sinus and a trace of a ninth can be seen at the extreme cardinal lateral angle of the shell. The plications and the grooves between them are evenly rounded—not angular. In mature shells of $1\frac{1}{2}$ cm. length the plications for the first half are smooth on molds of the interior, and exterior molds show only very fine concentric lines. After mid-growth the plications are crossed by strong lamellar concentric lines, about 0.5 mm. apart, and on occasional specimens the change in mode of growth is marked by a strong line of thickened shell depressing the forward part from the early shell growth, as in specimens 10 and 1 on the slab with figured specimen (fig. 11). The brachial valve has 4 plications raised above the general surface from the middle to front, and 7 plications each side and in very good specimens a trace of the eighth at the cardino-lateral angle. A thin median septum cuts the beak of the brachial valve and reaches to near the middle of the shell in molds of the interior. These charac-

ters are typically represented by the specimens on slab containing figured-specimen M1204.

Small shells from the same beds are like the corresponding part of the larger shells showing only smooth plications, thus representing the characters to which the names *Terebratula nucula* and *T. pulchra* were given by Sowerby.

In form the species presents the characters of *Rhynchonella lewisi* Davidson¹ except that the fold of the brachial valve is less elevated and "pinched," and the sinus shallower and broader than in the extreme form expressed by Davidson's fig. 25, in this particular assuming the form presented by his figure 26. In surface markings it differs from Davidson's species in that the "scalelike concentric ridges" do not cover the whole surface but begin rather abruptly about halfway from the beak to the front margin.

The number of plications is generally 20 and may be 22, but none have been seen with 26 plications. There are three depressed in the sinus and four elevated on the fold in all specimens counted. In dimensions our species is generally smaller than *R. lewisi* and more nearly equal in the two diameters. A typical pedicle valve (in mold) measures length 15 by 15 mm. A brachial valve (mold of interior) from the same beds (M1331.9) measures length 11 width 15 mm. Another pedicle (mold of exterior) measures 12 by 16 (M1206).

Davidson's figures of *R. lewisi* measure: Figure 25, 17 by 20 mm.; figure 26, 30 by 38 mm. (magnified); figure 28, 12 by 12½ mm. Our specimens are all in condition of molds of either exterior or interior and are more or less distorted by pressure in several cases.

The two short dental lamellæ of the pedicle valve and the median septum divided posteriorly to form an elongate cavity, are as in *Camarotæchia* and are very similar to that expressed in *Camarotæchia eximia* Hall of the Devonian. These characters were evidently referred to in his description of *Rhynchonella lewisi* and quoted by Davidson.²

Formation and locality.—Pembroke formation, gray shales outcropping on northern shore of Leighton Cove at end of the promontory of Pembroke Township, Washington County, Maine (loc. 5.3.8).

Cotypes.—Cat. Nos. 58962, 58963, U.S.N.M.

Genus LINGULA Bruguiere.

LINGULA SCOBINA, new species.

Plate 30, fig. 18 (enlarged 3 diameters).

Cf. 1839. *Lingula lewisii* SOWERBY, Sil. Syst., p. 615, pl. 6, fig. 9.

Cf. 1866. *Lingula lewisii* SOWERBY, Davidson, Brit. Sil. Brach., p. 35, pl. 3, figs. 1-6.

This species in size and form agrees very closely with Davidson's interpretation of Sowerby's species *L. lewisii*³ but the surface of one

¹ Brit. Sil. Brach., p. 180, pl. 23, figs. 25-28.

² Idem, p. 180.

³ Idem, p. 35, pl. 3, figs. 1-6.

of our specimens shows a very fine sculpturing which is reproduced (magnified about 3 diameters) in our figure 18 on plate 30. The definition of *L. lewisii* given by Davidson is in part, namely, "Sub-quadrate, oblong, longer than wide; sides almost parallel; front very slightly rounded; beaks obtusely angular; valves almost equally deep, the convexity very small." This applies to our shell. The size, "14 by 10 by 2½ lines," refers to the larger, not the smaller figures given by Davidson. His figure No. 2 measures 23 by 17 mm.

Our figured specimen measures 19 by 14, and a larger specimen from same locality measures 21 by 17 mm. Our shell differs, however, in surface sculpture. The concentric growth-ridges are much as in *L. lewisii*, but in addition to them our species is marked also by very sharply cut striæ crossing the shell, across the middle nearly parallel to the front border, but dropping downward on the sides where they appear as radiating from a point somewhat anterior to the beak. The striæ are undulating and on sides appear like cancellations from the crossing of the concentric striæ which there come close together. There are 24 of them to the centimeter in center of the magnified figure giving about 72 to the centimeter in the natural size shell. An inner layer of shell shows fine elevated radiating lines near the front, but these are not in evidence on the inner surface which appears smooth.

The surface sculpture is similar to that seen on the New York Devonian species *Lingula punctata* Hall; and a similar sculpturing is described for *L. granulata* and *L. tenuigranulata* of the Ordovician.¹ The shell is larger, more quadrate, and in form differs from the species *L. cornea* Sowerby which occurs higher up both in British rocks and in the formations about Eastport, Maine. It resembles the Clinton form *L. oblata* Hall, but is a much larger shell.

Formation and locality.—Pembroke formation, in the shales outcropping at head of Leighton (Schooner) Cove on south end of the Pembroke peninsula, Washington County, Maine (loc. No. 5.3.8M³).

Holotype.—Cat. No. 58967, U.S.N.M.

LINGULA MINIMA var. AMERICANA, new variety.

Plate 31, fig. 6.

Cf. 1839. *Lingula minima* SOWERBY, Sil. Syst., p. 612, pl. 5, p. 23.

1866. *Lingula minima* SOWERBY, Davidson, Brit. Sil. Brac., p. 48, pl. 2, figs. 36-44.

Sowerby neither by his definition nor his figures made it clear wherein *L. minima* differs from *L. cornea*, and M'Coy regarded them as identical, saying at close of definition of the species *L. cornea*, "The *L. minima* does not show the slightest difference that I can perceive."²

¹ Davidson, Brit. Sil. Brach., pp. 36 and 37.

² Brit. Pal. Foss., p. 251.

Davidson, however, recognized the distinctness of the two species and redefined *L. minima* as follows:

Shell small, oblong, elongated; sides curved, gradually merging into the slopes forming the acuminate pointed beaks; front rounded; valves slightly convex and marked with fine concentric striæ. Two specimens measured 4 by $2\frac{1}{2}$ and 5 by $2\frac{1}{2}$ lines (the latter a Lesmahago specimen).

And on his plate 2 the difference between the two species becomes clearly manifest.¹

Adopting Davidson's interpretation of the species *L. minima*, I can find little other than varietal modification to separate our Pembroke Lingulas from *L. minima*. Our shell is a little more slender than the Davidson figures average.

The specimens figured by Davidson from Lesmahago called *L. unguiculus* Salter MS. approach more nearly the general characters of the American variety than do those from the Downton sandstone, old Leominster Road near Ludlow, which is probably closer to the type as defined by Sowerby. In case our variety were to be regarded as of specific rank separate from *L. minima*, the name *L. unguiculus* Salter may be substituted.

The specimen I have figured is a fair average specimen; other specimens from the same purple shales differ in size, some larger and some smaller. They are all characterized by the elements of form described in the definition, and the larger number of specimens observed in the formation are smaller than the specimen figured. They differ from *L. cornea*, as figured and described (and as represented in the Eastport Lingulas) in the more curved side and front, the more acute beak, and the slightly greater length in proportion to width. The size, is, however, a diagnostic character. In the Pembroke formation Lingulas of the *cornea* type appear, but they are rarely seen in the Hersey red shale member, where the characteristic Lingula is the small one.

Formation and locality.—Pembroke formation, the upper red shales (Hersey member) on the shore of west side Sipp's Bay south of highway bridge, Pembroke (loc. No. 2.32.9A).

Holotype.—Cat. No. 58973, U.S.N.M.

Comments.—The figure given of this variety (pl. 31, fig. 6) represents a selected specimen of the average form and size (the figure is drawn twice the size of the original) of the Lingulas met with frequently in both the gray and the purple shales of the Pembroke formation. It is easily distinguished from the wider and larger species from the higher (Eastport) formation, which I have identified with *Lingula cornea* Sowerby. Specimens of a more slender and also of a wider form are represented in the collection. The variable form is

¹ Brit. Sil. Brach., p. 48, pl. 2, figs. 36-44.

indicated by the figures given by Davidson.¹ Our specimens from the Pembroke formation present similar variation in form, but throughout the formation are distinguished by their small size. They undoubtedly represent the *Lingula minima* Sowerby, and the application of a variety name to them (*L. minima* var. *americana*) is suggested by the difficulty experienced in determining which of the various forms expressed by Davidson's figures may be regarded as the type of the species.

PELECYPODA.

Genus ACTINOPTERIA Hall.

ACTINOPTERIA BELLA, new species.

Plate 30, figs. 17, 19.

Shell oblique, ovate; both valves convex; left valve the larger; posterior wing acuminate; anterior ear small, triangular; both wing and ear strongly defined from the central body part of the shell; beak of the left valve strong, rather broad, overarching the cardinal border, body of the shell convex, flattened over the center. Beak of right valve smaller than the left and scarcely reaching beyond the cardinal border; right valve gently convex, sloping gradually into the posterior wing; body portion separated from the anterior ear by a shallow furrow. Surface of the left valve over the body part crossed by rounded distinct radiating lines, which are absent from the ear and wing; crossed by finer concentric lines over the whole surface. The whole surface of the right valve crossed by fine concentric lines, without distinct radiating lines; upon some specimens very faint radii are visible over the body portion. In some large specimens referred to the species the radiating lines become obsolete upon the extreme border of the left valve, forming a rim of 2 or 3 mm. wide crossed only by concentric lines.

Dimensions of type-specimen (No. M1216.1, pl. 30, fig. 17, a left valve) from tip of anterior ear to posterior-ventral angle, 22 mm.; hinge, 18 mm.; hinge to vent margin, 14 mm. Corresponding measurements of cotype of right valve (specimen No. M1217, pl. 30, fig. 19), 19, 20, and 13 mm. Smaller specimens than the types show the beak of the left valve narrower and more gibbous, but in full-sized specimens the central body portion becomes broadly convex.

Formation and locality.—Shales of Pembroke formation at the head of Leighton Cove, at the southern end of Pembroke Township, Washington County, Maine (loc. No. 5.3.8M¹).

Cotypes.—Cat. No. 58964, U.S.N.M.

¹ Brit. Sil. Brach., pl. 2, figs. 36-44.

ACTINOPTERIA FORNICATA, new species.

Plate 30, figs. 14, 15, 16.

This species resembles *A. bella* in its general form, but differs from it by its greater convexity, more prominent and narrower beak and elevated narrow body of the left valve. The type-specimen is smaller than the majority of specimens referred to the same species from the same locality and is chosen as type on account of showing both valves. Left valve: The beak of the left valve is pointed, arching over the hinge and rapidly rises to the high arched narrow body which broadens gradually as it proceeds to the front; at the middle of the shell the anterior and posterior slopes are nearly symmetrical. The wing is flattened and produced at the cardinal margin into a short acuminate point which extends slightly beyond the postero-ventral angle. The anterior ear is prominent, arched at its center, and acutely pointed and separated from the body by a shallow sulcus. Radiating lines sharp and fine over the umbones become broader toward the front and are restricted to the body portion of the shell; they are crossed by finer concentric lines which cover the whole surface, including the ear and wing, where they are more or less laminose. The right valve is low-convex; its beak is small but rather sharply defined and rises scarcely beyond the hinge line; the body is gently convex and is separated from the nearly flat ear by a shallow sulcus. The surface of the right valve is without radiating lines and shows some faint concentric lines. Dimensions: Hinge line, 25 mm.; from hinge to ventral margin perpendicular to the hinge, 15 mm.; from beak to postero-ventral corner, 20 mm. Thickness of the two approximated valves, 10 mm., of which about 7 belongs to the left valve. Two large specimens referred to the same species are 25 and nearly 30 mm. along the hinge line.

Formation and locality.—Shales of Pembroke formation on the northwestern shore of Young's Cove, Pembroke Township, Washington County, Maine (loc. No. 5.1.4B). Cat. No. M1385.

Holotype.—Cat. No. 58965, U.S.N.M.

ACTINOPTERIA DISPAR, new species.

Plate 30, figs. 20, 21.

This species, of which left valves only are in evidence, is of the general type of *A. bella* but differs from it in its more erect form.

Shell elongate-ovate, erect, moderately convex; beak strong, rather wide and overarching. Body of shell low-convex, elongate, spatulate, its axis nearly erect, inclined slightly backward. Posterior and anterior margins nearly straight and subparallel, greatest width at hinge margin. Posterior wing triangular, flattened, and terminating

in an acute point. Ear smaller than the wing. Surface of body of shell covered by fine rounded radii, which in larger shells cease before reaching the ventral margin and are wanting on the ear and wing, crossed by fine concentric lines and coarse wrinkles, which become lamellose upon the wing and ears, and in full-grown specimens along the ventral margin form there a band of sometimes 3 or 4 mm. width, upon which the radii cease.

A small specimen (pl. 30, fig. 21, magnified) is referred to this species. It appears to possess all the characters of the larger specimens shown on the early stage of their growth, except that on the anterior slope of the body the radii extend faintly across the sulcus of the ear, but are not present upon the main area of the ear or upon the wing.

Dimensions of the type specimens (pl. 30, fig. 20): Length of hinge, 19 mm.; length of body from hinge to ventral border, 20 mm.; from tip of beak, 22 mm.; from end of anterior ear to postero-ventral angle, 23 mm.; width across center of shell, 18 mm. Young specimen: Greatest width at hinge, 9; at middle of shell, $8\frac{1}{2}$; from hinge to front, 9; from tip of beak, 11; tip of ear to post. vent. angle $11\frac{1}{2}$ mm.

Formation and locality.—Pembroke formation at head of Leighton Cove, Pembroke, Maine (loc. No. 5.3.SM²).

Cotypes.—Cat. No. 58966, U.S.N.M.

Genus GRAMMYSIA Verneuil.

GRAMMYSIA PEMBROKENSIS, new species.

Plate 31, fig. 2.

This species from the purple sandstones of the upper part of the Pembroke formation is similar to *G. cingulata* Hisinger of the Upper Silurian of Great Britain. It differs from the figures of that species given by Salter¹ in its narrower more transverse form and the more angular anterior termination of the cardinal angle. In size it is smaller, and our specimens show only a single furrow on the left valve. The dimensions of our figured specimen (Cat. No. M1238) (which is a mold, the figure having been drawn from a wax impression of the specimen) are greatest transverse length 32 mm., across the shell perpendicular to hinge line from termination of sulcus to the cardinal margin $12\frac{1}{2}$ mm. The figure is slightly enlarged. A second specimen of the same form (Cat. No. M1303) is $36\frac{1}{2}$ mm. long; it is extended farther forward of the sulcus than the first specimen. A third specimen (M1303.2) a left valve is $31\frac{1}{2}$ mm. long transversely,

¹ Mem. Geol. Surv. Great Britain, vol. 2, pt. 1, 1848, pl. 17, figs. 1, 2.

and, approximately, 13 mm. across at end of sulcus (the edge is broken in that specimen). Only a single sulcus is seen on the left valve. Specimens figured as fig. 1 and 3 are probably distorted examples of this species.

Formation and locality.—Upper part of the Pembroke formation (Hersey red shale member) in Pembroke village at the three localities numbered 2.32.9A, 2.42.8A, and 2.52.3A.

Holotype.—Cat. No. 58968, U.S.N.M. (also M1303 and M1303.2).

GRAMMYSIA TRIANGULATA (Salter).

Plate 31, fig. 17.

1848. *Orthonota triangulata* SALTER, Mem. Geol. Surv. Great Britain, vol. 2, pt. 1, Pal. append., p. 361, pl. 18, fig. 7.

1855. *Grammysia cingulata* var. *triangulata* SALTER, M'Coy, Brit. Pal. Foss., p. 280, pl. 1k, fig. 28.

The figure we have given of a specimen from the Pembroke formation is very near both in form and size Salter's figure 7.

Formation and locality.—Tough gray sandstone of the Pembroke formation at the head of Long Cove, Pembroke Township (loc. No. 5.2.9A).

Plesiotype.—Cat. No. 58970 U.S.N.M.

Genus LEIOPTERIA Hall.

LEIOPTERIA RUBRA, new species.

Plate 31, fig. 4.

This shell belongs to the same group of forms defined by Hall from the Niagara under the names *Avicula undata*, *A. subplana* and *Posidonomya ? rhomboidea*.¹ Its characters are not sharply defined, but in general form our species resembles *A. undata* Hall and differs from that species in a more gibbous umbonal region the beak protruding higher above the cardinal border, and the body more swollen, and the shell is somewhat more extended along the umbonal ridge making its form more elongate.

The surface markings are a few concentric lines of growth otherwise smooth. The posterior wing is well developed and submucronate. The anterior ear is not in evidence.

I figure the specimen and give it a name as it is the only specimen of the aviculoid type discovered in the Hersey red shale member of the Pembroke formation.

Formation and locality.—Hersey red shale member of the Pembroke formation, at head of Giffs Bay (loc. No. 2.32.6A).

Holotype.—Cat. No. 58971, U.S.N.M.

¹ Pal. New York, vol. 2, pl. 59.

Genus EURYMYELLA Williams.

EURYMYELLA SHALERI var. MINOR Williams.

Plate 31, fig. 5.

1912. *Eurymyella shaleri* var. *minor* WILLIAMS, Proc. U. S. Nat. Mus., vol. 42, p. 387, pl. 49, fig. 9.

This variety is occasionally seen in the Hersey red shale member of the Pembroke formation, and does not seem to differ appreciably from the common form of the Eastport formation. Specimens of the typical species *E. shaleri* have not been seen in these lower beds.

Formation and locality.—Hersey red shale member of the Pembroke formation, on the west shore of Sipps Bay, south of the highway bridge (loc. No. 2.32.9A).

Plesiotype.—Cat. No. 58972, U.S.N.M.

Genus MODIOLOPSIS Hall.

MODIOLOPSIS LEIGHTONI, new species.

Plate 31, figs. 7, 8, 9, 10.

This species is very common in some layers of the Pembroke formation, and shows considerable variation in form and size. The specimens selected for illustration (figs. 7, 8, 9, 10) together express fairly the general appearance of the shell. As the illustrations show no two specimens are exactly alike. In the following definition are noted the characters expressed by average specimens.

Shell transversely subovate; length a little more than twice the height; hinge line nearly straight; posterior height slightly greater than anterior. Beak within the anterior third of hinge length, low, flattened, ovate, arching; the umbonal ridge strong, gradually flattening out toward postero-ventral angle. Middle of shell flattened, slightly depressed from over the beak to the front. Surface covered by irregular lines of growth.

Two specimens taken as expressing average size and dimensions measure: Cat. No. M1351.35, length, 21; height at middle, $9\frac{1}{2}$; at beak, 9 mm. Cat. No. M1351.4, length, $22\frac{1}{2}$; height at middle, 10; at beak, 9 mm.

The corresponding dimensions of Billings's figure of *M. exilis* from the Arisaig (pl. 8, fig. 6) are 40 by 16 by 14, showing the difference in size in comparison with a species perhaps more nearly related to this one than any other American described species.

Formation and locality.—Pembroke formation, in Leighton gray shale member, at head of Leighton Cove, Pembroke Township (loc. No. 5.3.8F and M).

Cotypes.—Cat. No. 58974, U.S.N.M.

MODIOLOPSIS LEIGHTONI var. QUADRATA, Williams.

Plate 31, figs. 12, 13.

This variety has the surface markings very similar to and varying as in *M. leightoni* but it differs from the typical form in its greater height. The antero-posterior diameter exceeds the height by about a third, whereas in the typical form the length is about twice the height. The specimens figured do not express the average size. Figure 13 represents the largest specimen in the series and fairly expresses the general form, except that the surface is distorted by some hard fragment underlying it. Figure 12 has the front side a little shorter than usual, giving the vertical margin greater obliquity than the species generally exhibits. It is also somewhat crushed irregularly.

The two specimens (Cat. No. M1349.7 and M1351.32) give the characters of the variety in its medium expression. Intermediate forms between this and the typical species are also seen in the series from the same locality.

Formation and locality.—Pembroke formation, in Leighton gray shale member at head of Leighton Cove, Pembroke Township (loc. No. 5.3.8F and M).

Cotypes.—Cat. No. 58975, U.S.N.M.

Genus NUCULITES Conrad.

NUCULITES CORRUGATA, new species.

Plate 31, figs. 11, 14.

Shell elongate ovate, thin, about twice as long as high; hinge line nearly straight; front evenly rounded. Posterior end extending backward and subangulate. Beak, within the anterior third of length of shell, but varying in the several specimens. Surface smooth except for faint concentric lines of growth and crossed by several faint radial grooves on the posterior half of the right valve. On the left valve these consist of two umbonal ridges separated by a broad furrow; in one specimen there appears a secondary ridge in middle of the furrow. These radiating ridges and furrows are faintly expressed and are nearly obsolete in some specimens. The clavicular ridge is slender and long, in some specimens reaching beyond the middle. Its inclination varies considerably in the specimens and the proportions of the shell also vary. The differences, however, appear to be due partly at least to distortion during and since fossilization.

The species resembles *Nuculites oblongatus* Conrad, also Beushausen's figure 11 on his plate 5 of *Cucullella elliptica* Mauer. It differs from both in the radiating ridges and furrows and in the subangulate posterior margin.

Formation and locality.—Pembroke formation, in the Leighton gray shale member at the head of Leighton Cove, Pembroke Township (loc. No. 5.3.8.F).

Cotypes.—Cat. No. 58976, U.S.N.M.

GASTROPODA.

Genus PLATYSCHISMA McCoy.

PLATYSCHISMA HELICITES (Sowerby).

Plate 31, figs. 15, 16, and 18.

1839. *Trochus helicites* SOWERBY, Sil. Syst., p. 603, pl. 3, figs. 1e and 5.1888. *Platyschisma helicites* (Sowerby) ETHERIDGE, Foss. Brit. Isl., vol. 1, Paleozoic, p. 114.

This common Ludlow species is represented by numerous specimens in several horizons of the upper part of the Pembroke formation. It has not been detected either in the Edmunds below or the Eastport above, and is therefore, for the Eastport area, a characteristic Pembroke species.

Locality.—Hersey red shale member of the Pembroke formation, eastern shore of Hersey Cove, Pembroke Township (loc. No. 2.42.8A and 2.52.3A).

Plesiotypes.—Cat. No. 58977, U.S.N.M.

EXPLANATION OF PLATES.

PLATE 29.

New species from the Edmunds formation of Washington County, Me.

Figs. 5, 6, 7, 13, 14, 15, 16, 17, 18, natural size.

Figs. 1, 2, and 4, slightly enlarged.

Fig. 3, enlarged $2\frac{1}{2}$ diameters.

Figs. 8, 9, 10, 11, 12, enlarged 2 diameters.

Whitfieldella edmundsi Williams.

Figs. 1, 2, 4.—Brachial, front and pedicle view of a specimen of ordinary size.

Fig. 3.—A small specimen, showing the interior spiral arms.

Locality: East shore of Burnt Cove, south of Cunningham Mountain, Edmunds Township, Washington County, Me. (loc. No. 5.51.5B).

Cat. No. 58944.

Chonetes cobscooki Williams.

Fig. 5.—Mold of the interior of a pedicle valve, showing a form less transverse than some of the specimens of the species and the finer and more numerous lineations than on *Chonetes striatella* Dalman.

Locality: Calcareous shales south of Field Point, Edmunds Township (loc. No. 8.21.1A).

Cat. No. 58949.

Chonetes edmundsi Williams.

Figs. 6, 7.—Pedicle and brachial valves normal size.

Fig. 8.—An enlarged view of a pedicle valve showing spines.

Fig. 9.—Mold of interior of pedicle valve, enlarged.

Locality (specimens 6, 7, and 8 from): One half mile south of Field Point, west shore of Cobscook River, Edmunds Township (loc. No. 8.21.1A); Spec. No. 9, west side Burnt Cove, Edmunds Township (loc. No. 5.51.5A).

Cat. Nos. 58945, 58946.

Brachyprion shaleri Williams.

Fig. 10.—Mold of the interior of a pedicle valve, showing the short crenulated area and smooth terminal portion of the hinge and the subquadrate form of the muscular area bounded by strong subparallel ridges.

Locality: West shore Cobscook River, opposite Wilbur Point, Edmunds Township (loc. No. 8.21.1A).

Cat. No. 58952.

Fig. 11.—Exterior of a small pedicle valve showing the surface sculpture.

Locality: Shore of the small bay west of Field Point, southeast of Balls Mountain, Edmunds Township (loc. No. 8.1.8A).

Cat. No. 58951.

Fig. 12.—Mold of the interior of a brachial valve, showing the hinge crenulations, the cardinal process, the dental sockets, and the strong ridges bounding the muscular impression.

Locality: East shore of Burnt Cove, south of Cunningham Mountain, Edmunds Township (loc. No. 5.51.5B).

Cat. No. 58950.

Palaeopecten cobscooki Williams.

Fig. 13.—A nearly complete mold of the interior of a left valve, showing the erect form, the characteristic radii, the pectenoid form, and the crural ridges. This specimen is the type of the new genus *Palaeopecten* as well as of the new species *P. cobscooki*.

Locality: East shore of Cobscook River, outside Carrying Place Cove on western side of township of Trescott (loc. No. 5.52.9A).

Cat. No. 58953.

Pterinea (?*Tolmaia*) *trescottii* Williams.

Fig. 14.—A specimen showing the interior of a right valve, its low umbonal region, and concave toward the front.

Locality: Near the end of Crow Neck on the east side of North Trescott (loc. No. 5.33.8A).

Fig. 15.—A left valve, showing natural mold of the exterior with the strong radii, trace of the cardinal teeth and lateral tooth, and well defined and developed anterior ear.

Locality: Same as figure 14.

Cat. No. 58955.

Tolmaia campestris Williams.

Fig. 16.—A left valve, figured from a wax mold of the original specimen, showing the reticulated surface sculpture covering the body and both ear and wing.

Locality: Field Point on west shore of Cobscook River, Edmunds Township (loc. No. 8.1.8D).

Cat. No. 58956.

Palaeopecten transversalis Williams.

Fig. 17.—Mold of the interior of a left valve, showing the transversely elongate form, the rays, and absence of a differentiated anterior ear.

Locality: East shore of Cobscook River, same locality as figure 13.

Fig. 18.—Mold of exterior of same specimen.

Cat. No. 58954.

PLATE 30.

New species from the Pembroke formation of Washington County, Maine.

Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, enlarged $1\frac{1}{2}$ diameters.

Figs. 17, 19, slightly enlarged.

Fig. 21, enlarged 2 diameters.

Fig. 18, enlarged 3 diameters.

Figs. 10, 14, 15, 16, 20, natural size.

Dalmanella lunata (Sowerby).

Fig. 1.—A pedicle valve drawn from rubber mold of the exterior.

Locality: Head of Leighton Cove, Pembroke Peninsula, Washington County, Maine (loc. No. 5.3.8M³).

Cat. No. 58957.

Fig. 2.—A small specimen of pedicle valve (?young), a natural mold of the interior.

Locality: Leighton Cove, higher up in section than figure 1 (loc. No. 5.3.8F).

Cat. No. 58958.

Fig. 3.—A pedicle valve of the wider form, taken from a wax mold of the exterior.

Locality: Same as figure 1.

Cat. No. 58957.

Fig. 4.—A small brachial valve (?young), showing the narrow form of *Orthis elegantula* Dalman.

Locality: Same as figure 2.

Cat. No. 58958.

Fig. 5.—A brachial valve, drawn from a wax mold of the exterior, showing the characteristic surface sculpture.

Locality: Same as figure 1.

Cat. No. 58957.

Fig. 8.—A pedicle valve of the wide variety.

Locality: Leighton Cove, a few feet higher in the section than figure 1 (loc. No. 5.3.8.M¹).

Cat. No. 58959.

Chonetes bastini Williams.

Fig. 6.—Exterior of a pedicle valve.

Locality: Leighton Cove, Pembroke Township (loc. No. 5.3.8F).

Cat. No. 58960.

Fig. 7.—Exterior of a pedicle valve showing a median furrow.

Locality: Leighton Cove (loc. No. 5.3.8.M³).

Cat. No. 58961.

Fig. 10.—A slab showing several specimens natural size, showing both the variation in form and the very fine radial lines. The specimen in the left upper corner resembles *C. striatella* and the specimen on the right lower corner *C. nova scoticus*.

Locality: Same as figure 7.

Cat. No. 58961.

Camarotoechia leightoni Williams.

Fig. 9.—A brachial valve showing the median septum, and the concentric imbrications not showing till near the front.

Locality: Leighton Cove (loc. No. 5.3.8M¹).

Cat. No. 58962.

Fig. 11.—A pedicle valve, showing the concentric imbrications beginning suddenly at about mid growth, the sinus with three well defined plications.

Locality: Same as figure 9.

Cat. No. 58962.

Fig. 12.—A pedicle valve showing widening of the sinus toward front and beginning of division of the plications bounding the sinus.

Locality: Same as figure 9.

Cat. No. 58962.

Fig. 13.—Front view of specimen showing both valves. The specimen is compressed from front to back, making it to appear more gibbous than natural.

Locality: Leighton Cove, a few feet below locality of figure 9 (loc. No. 5.3.8M³).

Cat. No. 58963.

Actinopteria fornicata Williams.

Figs. 14, 15, 16.—Three views of the same specimen.

Locality: Shales of the Pembroke formation on northwestern shore of Young's Cove, Pembroke township (loc. No. 5.1.4 B).

Cat. No. 58965.

Actinopteria bella Williams.

Fig. 17.—A natural mold of the exterior of a left valve showing the concentric lines over whole surface, and the radiating lines confined to the body of the shell.

Locality: Leighton Cove (loc. No. 5.3.8M¹).

Cat. No. 58964.

Fig. 19.—Mold of the interior of a right valve, showing concentric lines over whole surface but no radii.

Locality: Same as figure 17.

Cat. No. 58964.

Lingula scobina Williams.

Fig. 18.—A specimen, enlarged 3 diameters, to show the peculiar surface sculpture and the radiating lines near the front on inner layer of the shell.

Locality: Leighton Cove, Pembroke (loc. No. 5.3.8M³).

Cat. No. 58967.

Actinopteria dispar Williams.

Fig. 20.—Mold of the interior of a left valve, ordinary size.

Locality: Leighton Cove, Pembroke (loc. No. 5.3.8M²).

Cat. No. 58966.

Fig. 21.—A small left valve, enlarged 2 diameters.

Locality: Same as figure 20.

Cat. No. 58966.

PLATE 31.

New species from the Pembroke formation of Washington County, Maine.

Specimen 5, enlarged 3 diameters.

Specimens 6, 15, 16, 18, enlarged 2 diameters.

Specimens 1, 2, 3, 4, enlarged 1½ diameters.

Specimens 7, 8, 9, 10, 11, 12, 13, 14, slightly enlarged.

Specimen 17, natural size.

Grammysia pembrokensis Williams.

Fig. 2.—A right valve, slightly more elongate transversely, and the front of the shell more sharply angular than ordinary.

Formation and locality: Hersey red shale member of the Pembroke formation on west shore northernmost cove of Sippys Bay (loc. No. 2.32.9 A).

Cat. No. 58968.

Grammysia cf. pembrokensis Williams.

Figs. 1 and 3.—Specimens showing considerable difference in form from the type which is believed to be due to distortion after fossilization.

Locality: Same as figure 2.

Cat. No. 58969.

Grammysia triangulata (Salter).

Fig. 17.—Specimen of a left valve presenting very closely the form of one of Salter's type figures.

Formation and locality: Tough gray sandstone of the Pembroke formation near base at head of Long Cove, Pembroke Township (loc. No. 5.2.9A).

Cat. No. 58970.

Leiopteria rubra Williams.

Fig. 4.—A small left valve.

Formation and locality: Hersey red shale member of Pembroke formation, at head of Sipps Bay, 100 yards south of highway bridge (loc. No. 2.32.6A).

Cat. No. 58971.

Eurymyella shaleri var. *minor* Williams.

Fig. 5.—A small specimen, magnified 3 diameters, showing the form of the type species, but of the small size, as it occurs in the Eastport formation.

Formation and locality: Hersey red shale member of the Pembroke formation on west shore of Sipps Bay, south of the highway bridge, Pembroke Township (loc. No. 2.32.9A).

Cat. No. 58972.

Lingula minima var. *americana* Williams.

Fig. 6.—A specimen slightly larger than ordinary (magnified 2 diameters), showing the general form and size of the species.

Locality: Same as Figure 5 (loc. No. 2.32.9A).

Cat. No. 58973.

Modiolopsis leightoni Williams.

Figs. 7, 8, 9, and 10.—A set of two right and two left valves showing the ordinary expression of the species where it is found in abundance, fluctuating both in form and surface characters.

Formation and locality: Argillaceous shales in the lower portion of the Pembroke formation. Leighton Cove, Pembroke Township (loc. No. 5.3.8F and M).

Cat. No. 58974, U.S.N.M.

Modiolopsis leightoni var. *quadrata* Williams.

Figs. 12, 13.—Two left valves showing the ordinary expression of the quadrate form.

Locality: Same as figures 7-10.

Cat. No. 58975.

Nuculites corrugata Williams.

Fig. 11.—A left valve, slightly shorter and ventral margin slightly more arched than ordinary.

Formation and locality: Gray argillaceous shale of lower part of Pembroke formation at head of Leighton Cove (loc. No. 5.3.8F).

Cat. No. 58976.

Fig. 14.—A right valve of nearly normal form, except that the ventral border is rolled under, making the edge nearly straight.

Locality: Same as figure 11.

Cat. No. 58976.

Platyschisma helicites Sowerby.

Figs. 15, 16.—Two views of a specimen somewhat crushed, making it to appear with lower spire than ordinary.

Formation and locality: Hersey red shale member of the Pembroke formation on eastern shore of Hersey Cove, Pembroke Township (loc. No. 2.42.8A).

Cat. No. M1243.

Fig. 18.—A slab showing molds of several small specimens which were probably immature.

Formation and locality: Hersey red shale member of Pembroke formation on eastern shore Hersey Cove (loc. No. 2.52.3A).

Cat. No. 58977.